National Institute of Environmental Health Sciences

Time series analysis of hand-foot-mouth disease hospitalization in Zhengzhou: Establishment of forecasting models using climate variables as predictors

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Abstract:

Background: Large-scale outbreaks of hand-foot-mouth disease (HFMD) have occurred frequently and caused neurological sequelae in mainland China since 2008. Prediction of the activity of HFMD epidemics a few weeks ahead is useful in taking preventive measures for efficient HFMD control. Methods: Samples obtained from children hospitalized with HFMD in Zhengzhou, Henan, China, were examined for the existence of pathogens with reverse-transcriptase polymerase chain reaction (RT-PCR) from 2008 to 2012. Seasonal Autoregressive Integrated Moving Average (SARIMA) models for the weekly number of HFMD, Human enterovirs 71(HEV71) and CoxsackievirusA16 (CoxA16) associated HFMD were developed and validated. Cross correlation between the number of HFMD hospitalizations and climatic variables was computed to identify significant variables to be included as external factors. Time series modeling was carried out using multivariate SARIMA models when there was significant predictor meteorological variable. Results: 2932 samples from the patients hospitalized with HFMD, 748 were detected with HEV71, 527 with CoxA16 and 787 with other enterovirus (other EV) from January 2008 to June 2012. Average atmospheric temperature (T{avg}) lagged at 2 or 3 weeks were identified as significant predictors for the number of HFMD and the pathogens. SARIMA(0,1,0)(1,0,0)52 associated with T{avg} at lag 2 (T{avg}-Lag 2) weeks, SARIMA(0,1,2)(1,0,0)52 with T{avg}-Lag 2 weeks and SARIMA(0,1,1)(1,1,0)52 with T{avg}-Lag 3 weeks were developed and validated for description and predication the weekly number of HFMD, HEV71-associated HFMD, and Cox A16-associated HFMD hospitalizations. Conclusion: Seasonal pattern of certain HFMD pathogens can be associated by meteorological factors. The SARIMA model including climatic variables could be used as an early and reliable monitoring system to predict annual HFMD epidemics.

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Resource Description

Early Warning System:

resource focus on systems used to warn populations of high temperatures, extreme weather, or other elements of climate change to prevent harm to health

A focus of content

Exposure :

weather or climate related pathway by which climate change affects health

Meteorological Factors, Solar Radiation, Temperature

Temperature: Fluctuations

Geographic Feature: ☑

resource focuses on specific type of geography

Urban

Geographic Location: ☑

resource focuses on specific location

Non-United States

Non-United States: Asia

Asian Region/Country: China

Health Impact: ☑

specification of health effect or disease related to climate change exposure

Infectious Disease, Other Health Impact

Other Health Impact: hand-foot-mouth disease

Mitigation/Adaptation: ☑

mitigation or adaptation strategy is a focus of resource

Adaptation

Model/Methodology: ☑

type of model used or methodology development is a focus of resource

Outcome Change Prediction

Population of Concern: A focus of content

Population of Concern: ☑

populations at particular risk or vulnerability to climate change impacts

Children

Resource Type: ☑

format or standard characteristic of resource

Research Article

Timescale: ☑

time period studied

Short-Term (

Vulnerability/Impact Assessment: ☑

resource focus on process of identifying, quantifying, and prioritizing vulnerabilities in a system

A focus of content